Cloud Native Computing:
Orchestrating Containers For Better Service and Application Deployments

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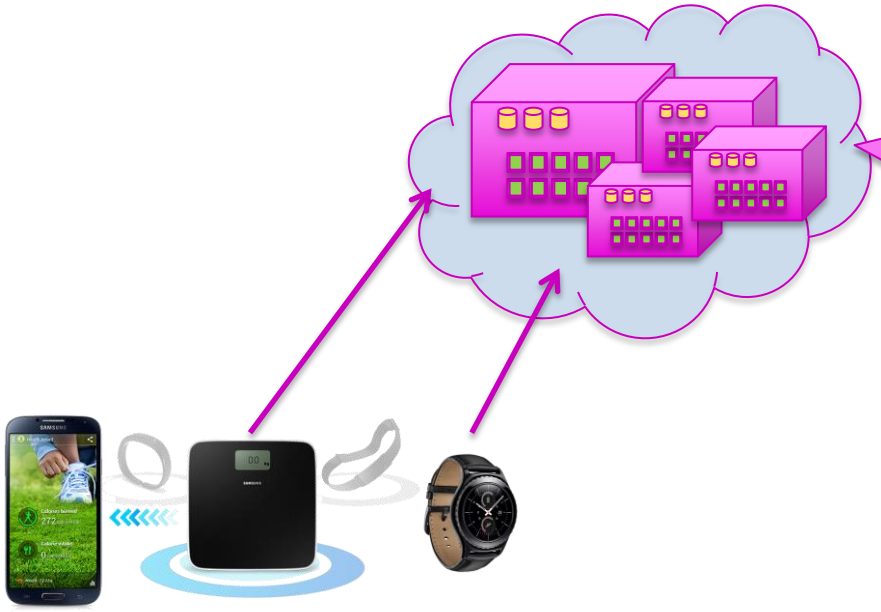


This Talk: New software to “orchestrate” the back-end of modern mobile & IoT services

Monolithic

Client-Server

N-tier

Microservices

Proprietary Mainframe

Open Systems

Virtualization

Cloud

Container-centric

Operators & Runbooks

Automation

Orchestration

Characterizing the Gap

Old School

Self-managed basic IT

Monolithic
Complex Dependencies

Gold Plated, Reliable Hardware
Expensive
Proprietary
Design to Prevent Failure

Large, Centrally Controlled Teams
Months to Production
Waterfall Process
Ponderous, Manual QA
Quality Issues
Costly

Cloud Native

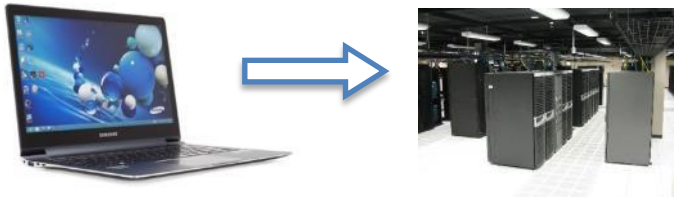
SaaS for basic IT (Email, etc)

Microservices
Lots of Simple, Independent Parts

Commodity Hardware
Software Reliability
Open Source
Designed to Fail
Chaos Monkey

Small, Independent Teams
Continuous Integration
Continuous Deployment
Changes Made in Minutes
High Quality
Ubiquitous Automation
Efficient

Driving Force: Containers



- Complex, distributed services built on notebooks, which then run, unmodified, on public or private infrastructure
- Isolation from dependencies & from each other
- Highly efficient (low memory footprint, low startup time, rapid scale up/down – often 10X overall improvement)

High Bar - Industrial Grade Compute
as practiced by Google, Facebook, Amazon, Twitter, …

- 70% Datacenter utilization
- 10,000-40,000 servers per admin
- Commodity hardware
- Extremely low licensing spend
- Comprehensive Automation
- Extensive Analytics
- Multiple releases a day / CD
- Destructive testing in production (chaos monkey)
- No-ops (Self service deployment)

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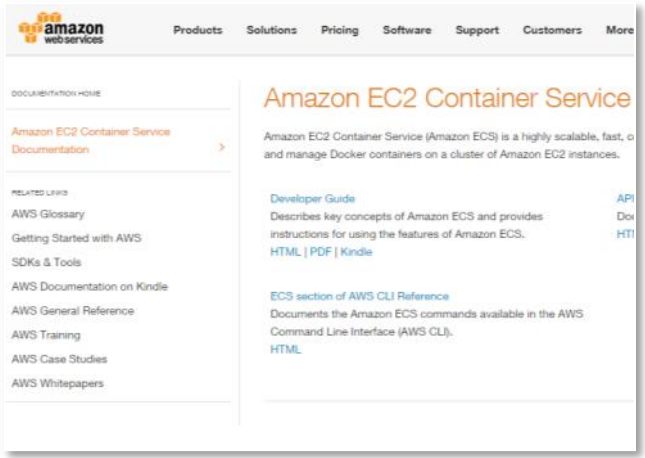
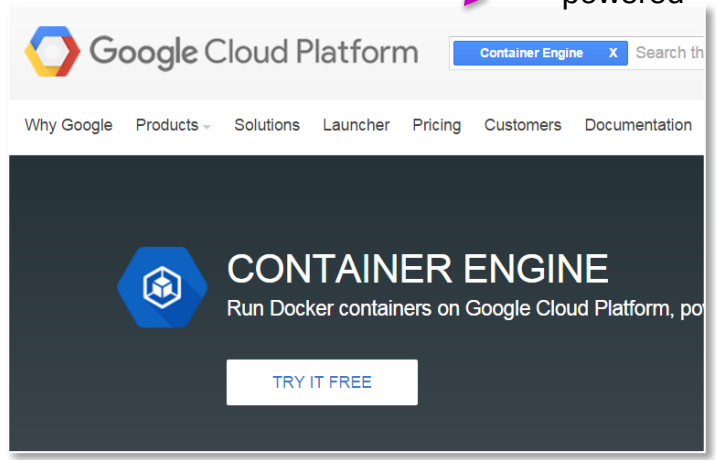
#GIFEE

cisco · CoreOS · docker · Google · HUAWEI · IBM · intel · Joyent · MESOSPHERE · redhat · SUPERNAP · Goldman Sachs · at&t · NetApp · APCERA · APPFORMIX · apprenda · cloudsoft · ClusterHQ · ContainerSolutions · CYCLE COMPUTING · Datawise.io · DEIS · ebay · eldarion · FUJITSU · iguaz.io · Infoblox · ishi systems · KISMATIC · CALICO · NCSOFT · NEC · NGINX · portworx · RANCHER · RX-M · Scalock · sysdig · Twistlock · box · UNIVA · Virtuozzo · vmware · weaveworks · WILLIAMS GARCIA · Centrify

Service Providers

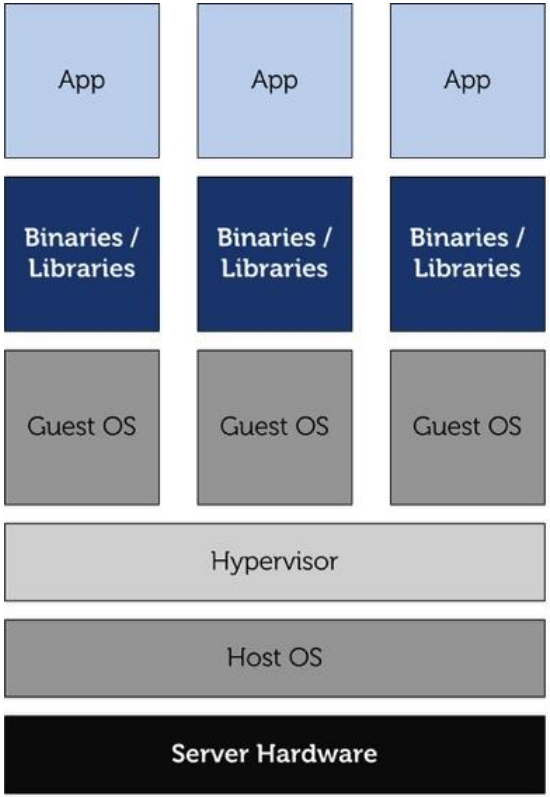
Kubernetes-powered



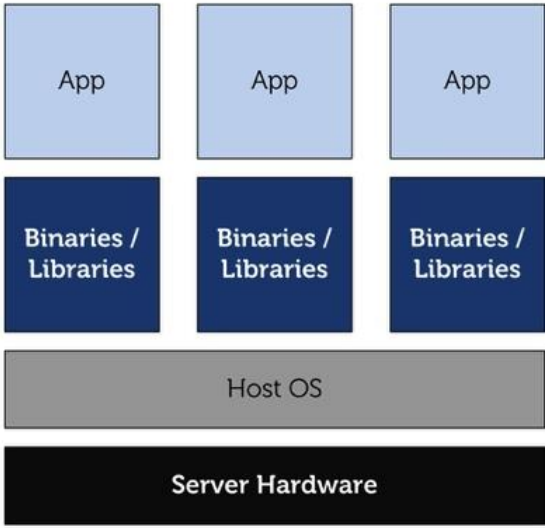


Quick refresher…
Container and Docker 101

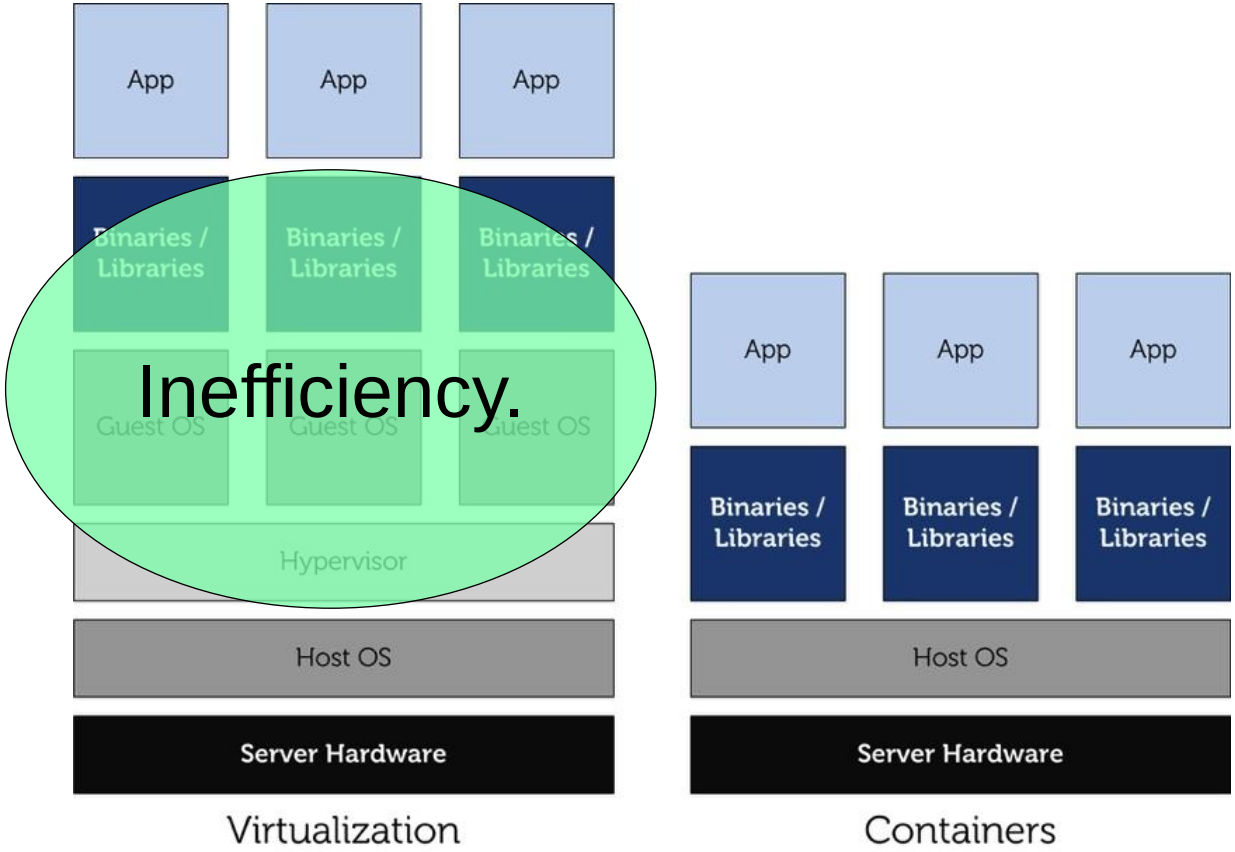
Containers and VMs



Virtualization



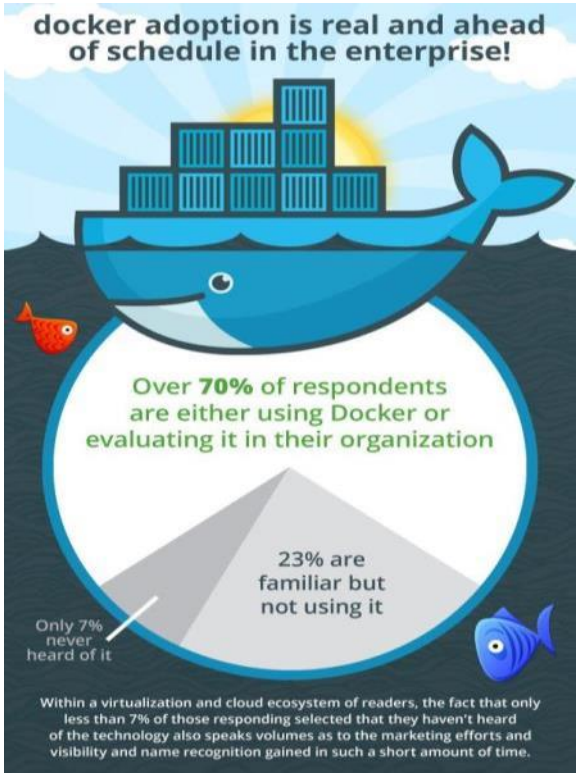
Containers

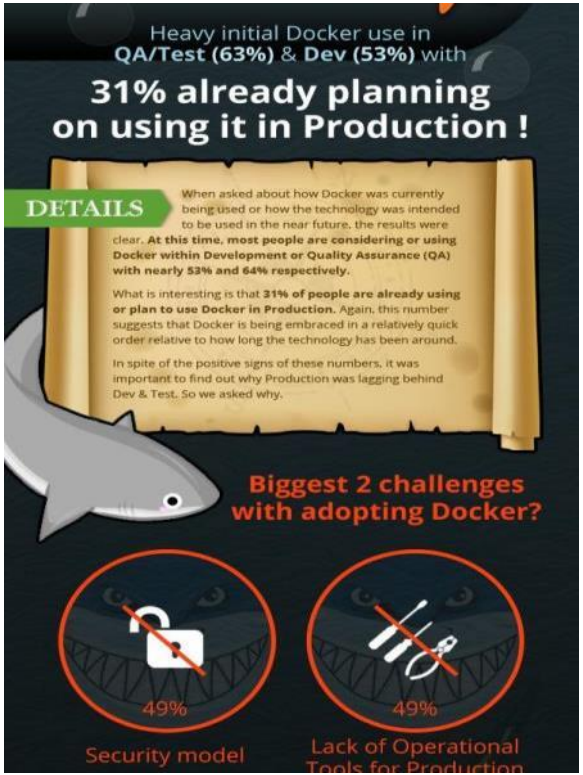

App
App
App
Binaries / Libraries
Binaries / Libraries
Binaries / Libraries
Guest OS
Guest OS
Guest OS
Hypervisor
Host OS
Server Hardware
Virtualization
Inefficiency.
App
App
App
Binaries / Libraries
Binaries / Libraries
Binaries / Libraries
Host OS
Server Hardware
Containers

Human Efficiency: Bigger Gains

- Docker's Breakthrough: Good tools and standardization built on top of mature container technology
- Method for deploying "anywhere" by ensuring all the dependencies get built into the container with the application
  - Better CI/CD
  - More automation in operations
  - More self-service and dev/ops
- Open source model → Collaboration → Velocity
  - Open repositories of images to start from… you can stand on the shoulders of giants
- Enables application designs that are better for humans to manage

Containers are mainstream…





www.docker.com

- Usage moving from the big service providers (Google, Twitter, etc.) to enterprises.
- Even very traditional enterprises are adopting the new technology - Cisco IT using Red Hat Openshift, Kubernetes and Containers for production workloads.

Disruptive Effects on Classic IT

- **Low Entry Barrier**
  - Serverless Startups
  - ShadowIT
- **Deprecates existing technologies**
  - Shared block storage (SANs)
  - Shared filesystems (NAS)
  - Legacy networking, e.g. h/w firewalls
  - Legacy “fat” Linux distros
- **Less Labor (Tinier Empire!!!)**
  - Automated deployment, scaling, repair, teardown
- **Cheaper servers and network h/w**
  - Strictly regimented, homogenous
  - Cattle, not pets.
- **Key technologies open sourced**

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It's NOT just Containers!

1. **Containers**: Benefits of VMs, but lighter weight, portable across laptops → massive scale deployment.

2. **Dynamically managed**: Services start, stop, scale up/down and are repaired automatically.

3. **Microservices**: Built from loosely-coupled, independently testable pieces – significantly increases the agility, scalability and maintainability of applications.

→ Faster to develop and deploy
→ Easier to scale (and autoscale!)
→ More efficient to operate
→ Much higher service quality
→ Far fewer outages

www.cncf.io

What's a Microservice???

- Not: 10-100 lines of code

- Loosely coupled architecture
  - Accessed via APIs (typically REST or http)
- Pieces independently…
  - Upgradable
  - Scalable
  - Developed (small teams)

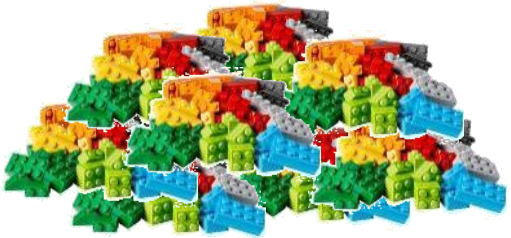
Org Impacts

- Microservices = Reorg
- Ops Automation + Specialization = Reorg
- High premium on technically proficient product management
- High premium on operations engineering, pipeline development, and internal platforms

Putting It All Together

- Your app or service
  - Pods (groups of containers on the same server image)
  - A description of your service: "*the model*" describing the pods, storage & network needs, health metrics, and scale up/down directives
- A cluster
  - Made up of a number of *nodes* (virtual or physical servers)
  - Connected by a physical network to each other and the internet
- A networking technology
  - An SDN or router technology to allow each service to operate independently of the others
  - Load balancers, …
- A "thin host"
  - CoreOS, Snappy, Atomic, Photon, …
- And an orchestration technology to glue everything together

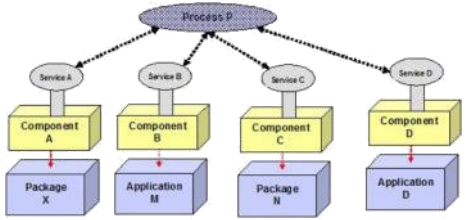
Kubernetes: The leading open source Cloud Native orchestration technology



Containers

Network & Storage Services

The Service



"Model"

(How the application should be deployed, connected, protected, scaled, repaired and torn down)

Servers

Kubernetes 101

www.kubernetes.io

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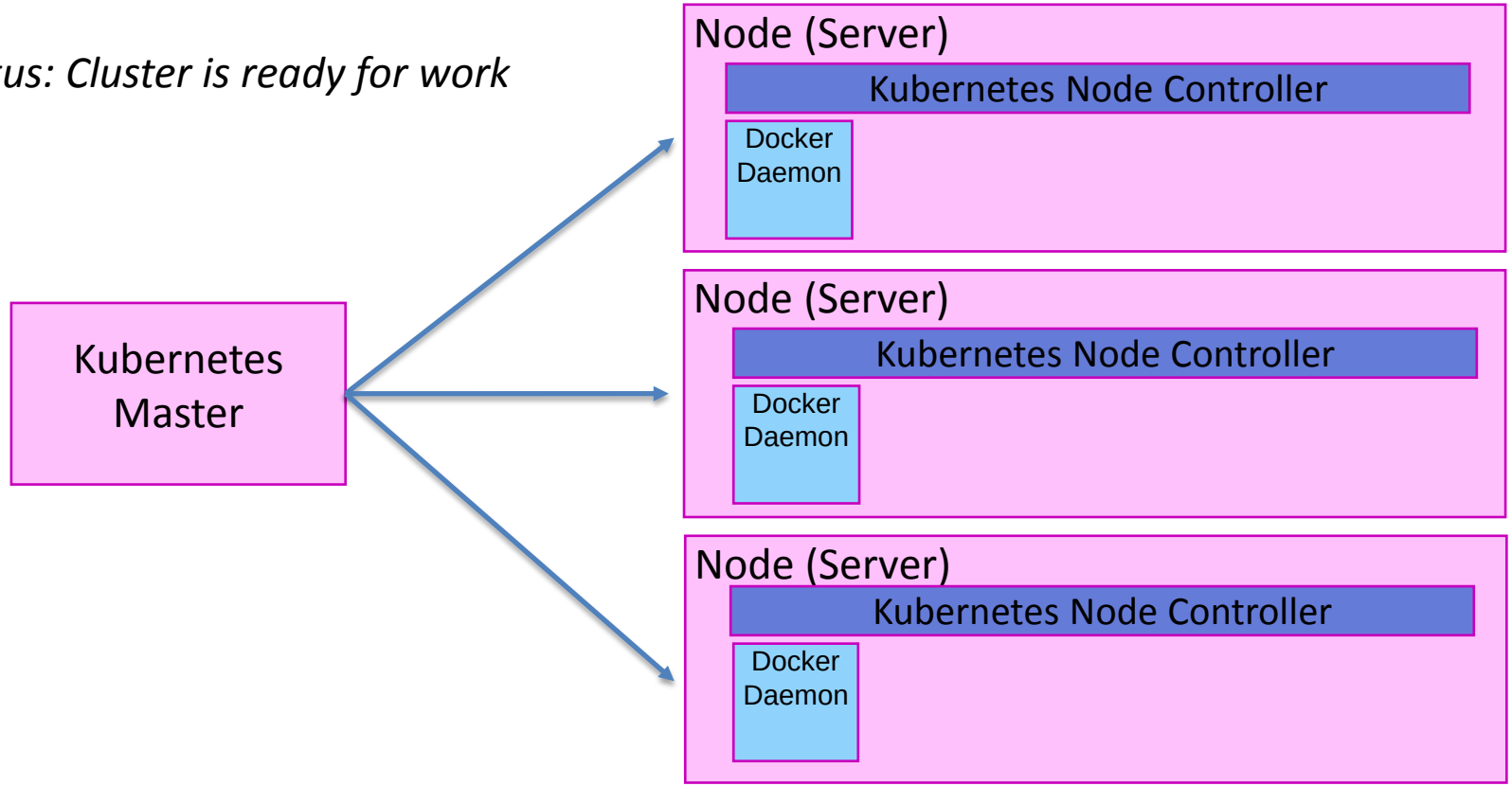
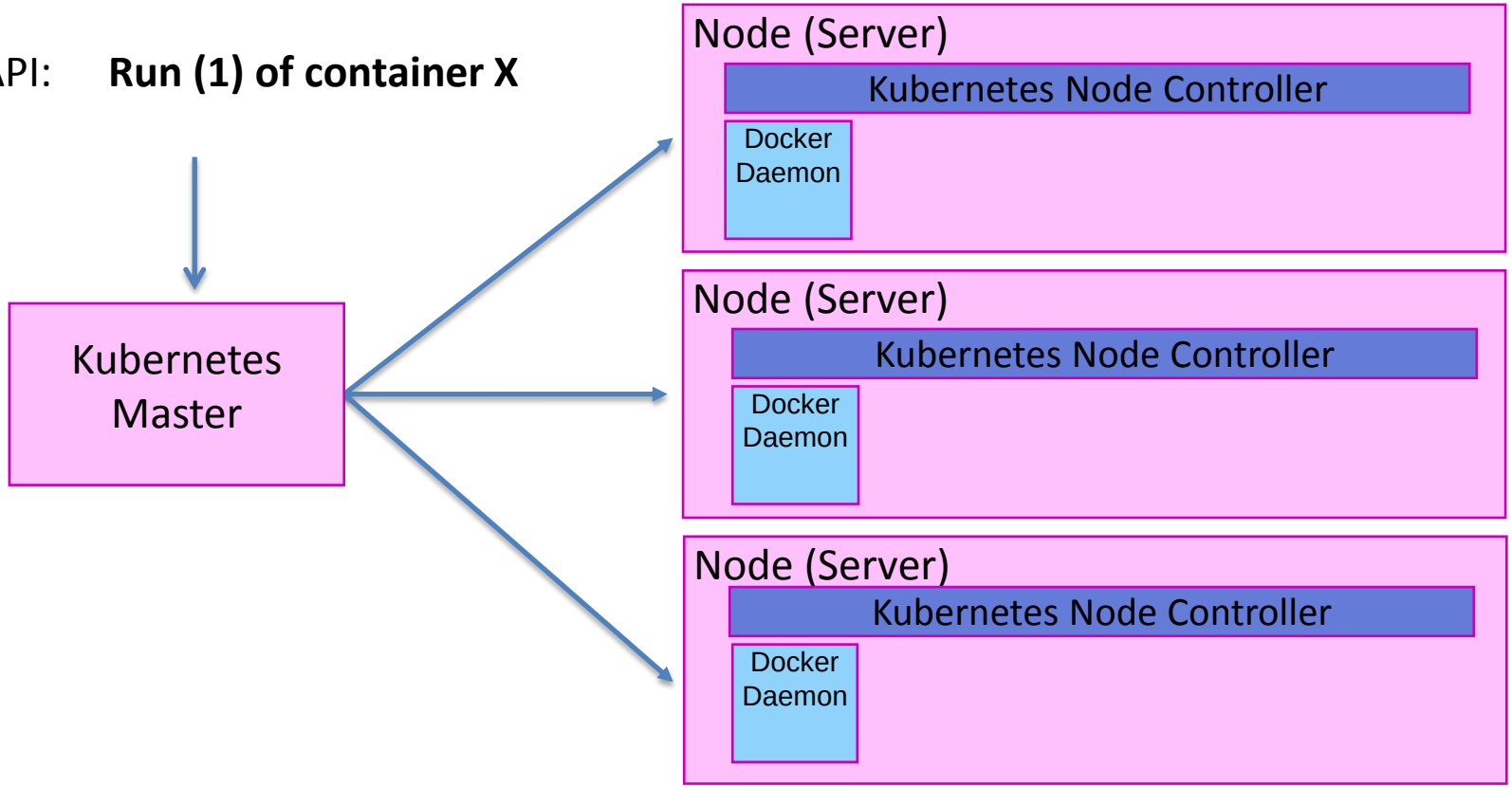
Kubernetes Conceptual

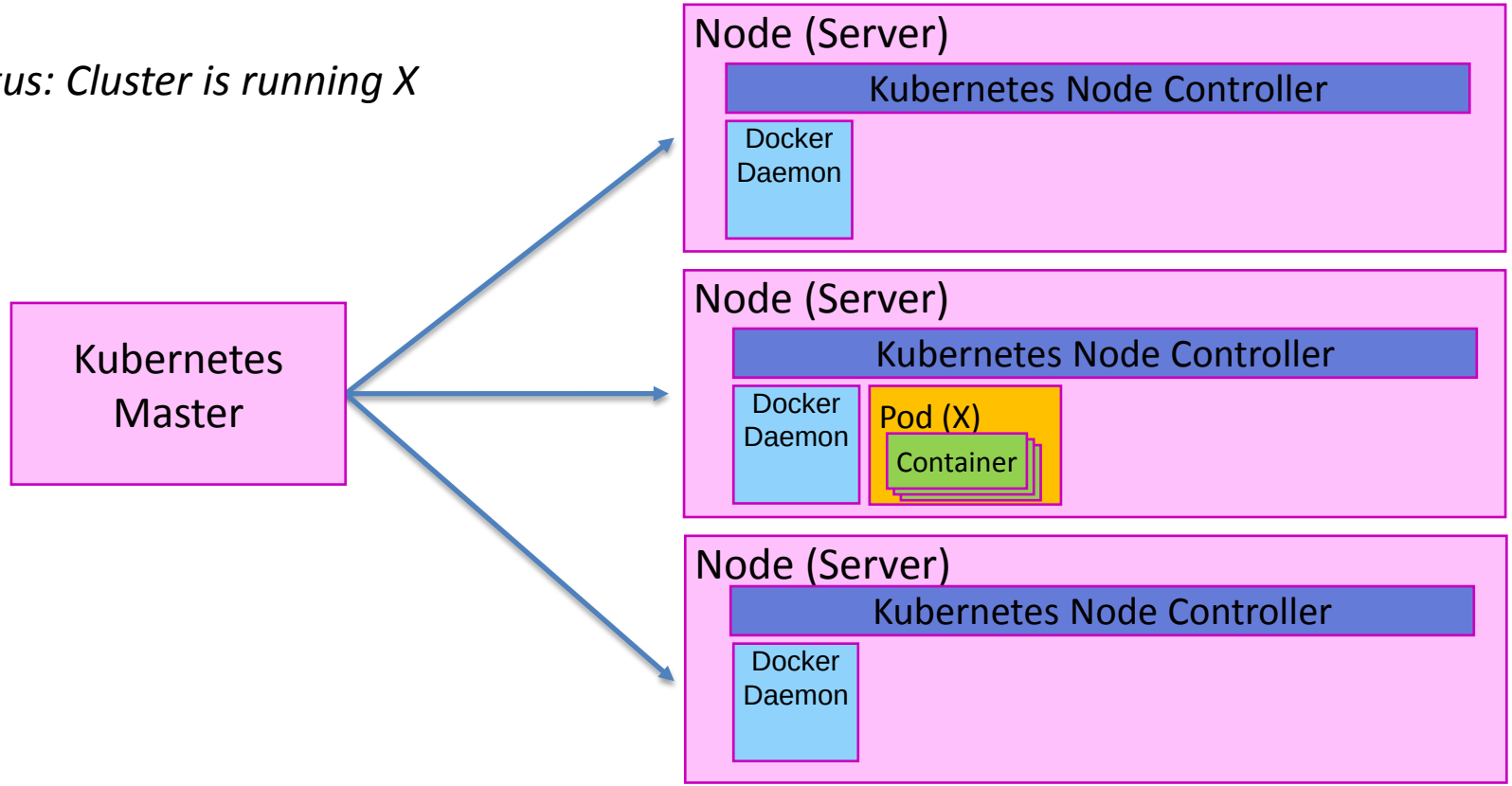
Status: Cluster is ready for work



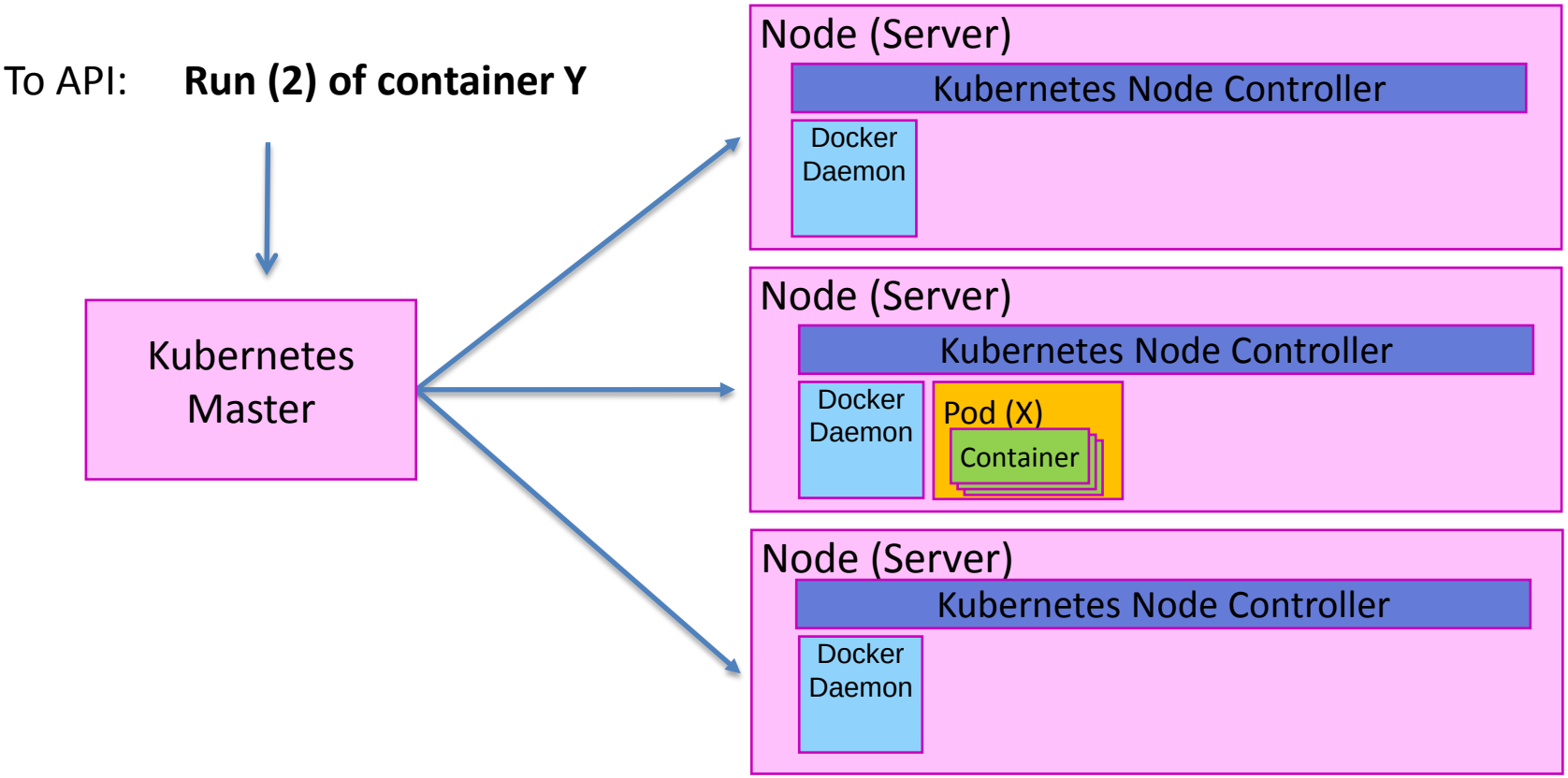
To API: **Run (1) of container X**



Status: Cluster is running X



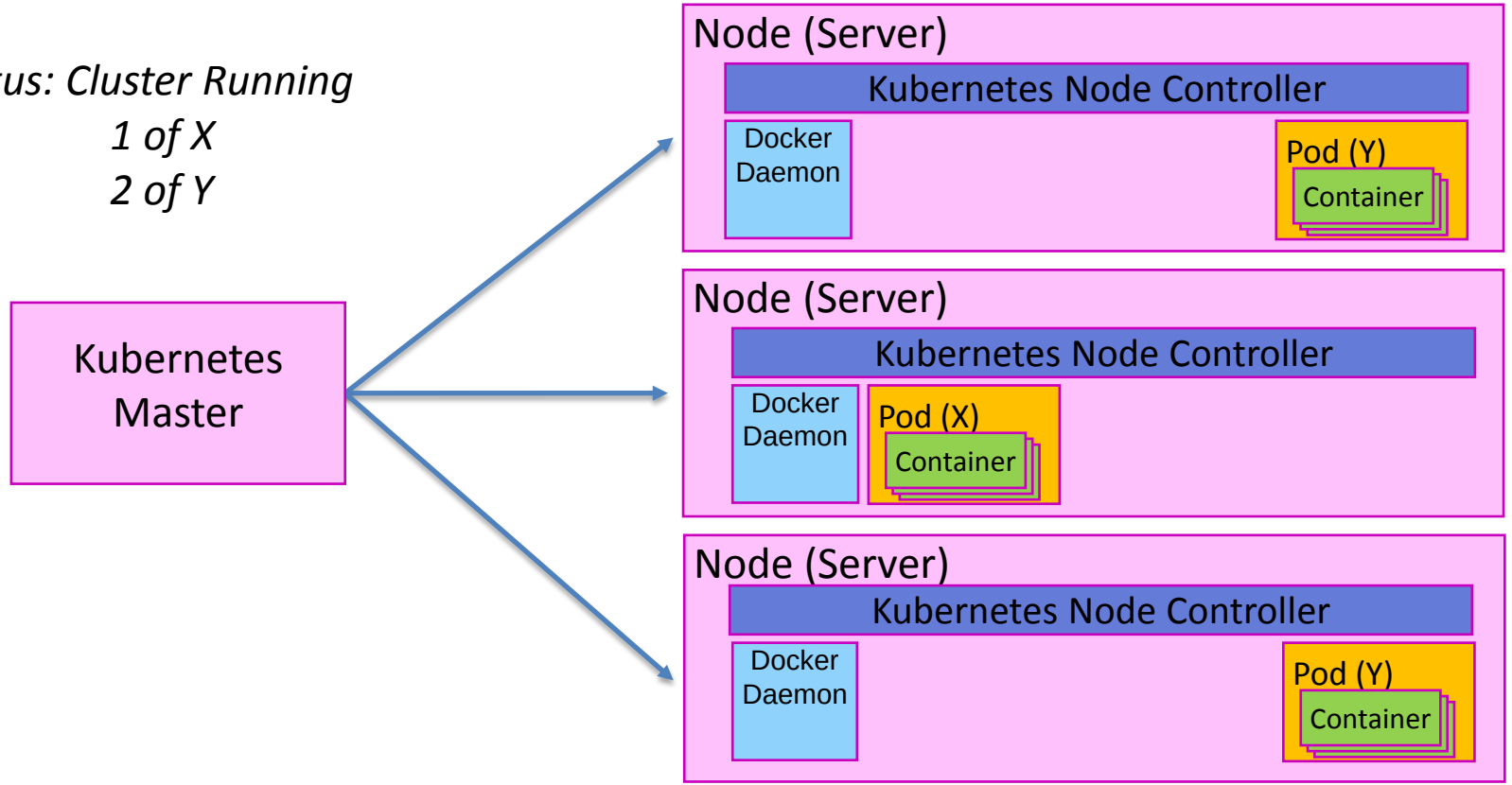
To API: **Run (2) of container Y**

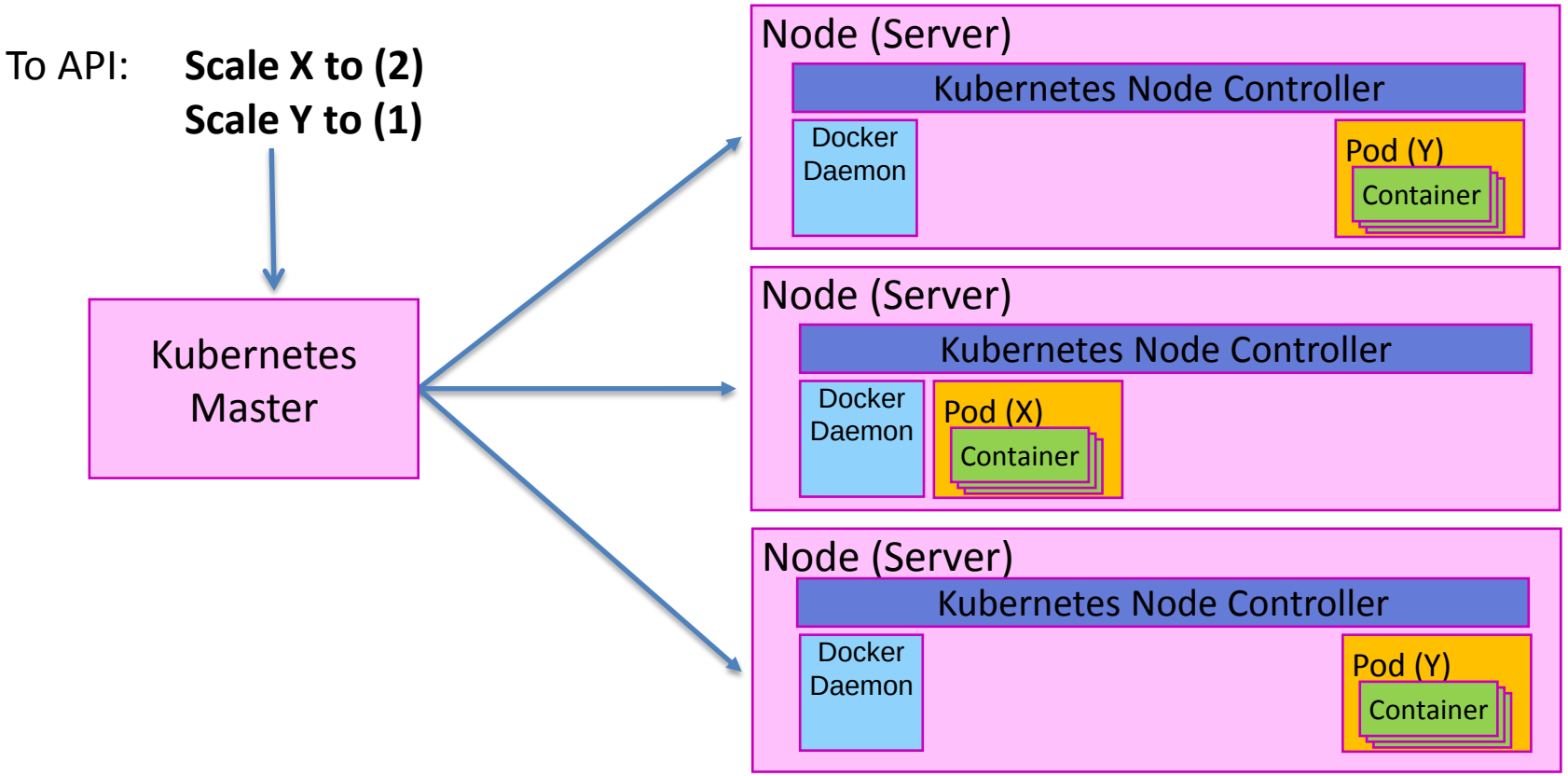


Status: Cluster Running

1 of X

2 of Y

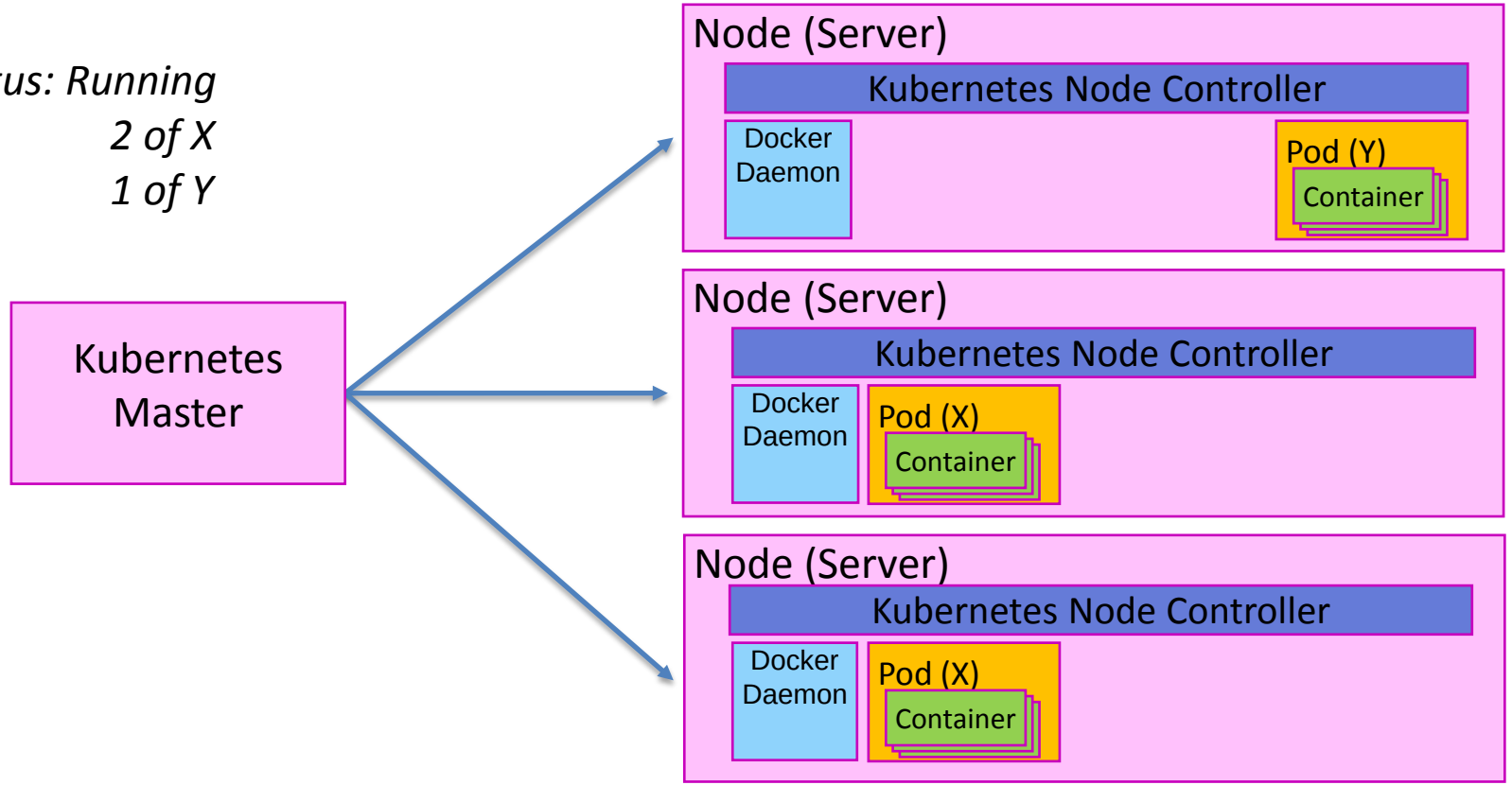



To API:
Scale X to (2)
Scale Y to (1)
Kubernetes Master
Node (Server)
Kubernetes Node Controller
Docker Daemon
Pod (Y)
Container
Node (Server)
Kubernetes Node Controller
Docker Daemon
Pod (X)
Container
Node (Server)
Kubernetes Node Controller
Docker Daemon
Pod (Y)
Container

Status: Running

2 of X

1 of Y

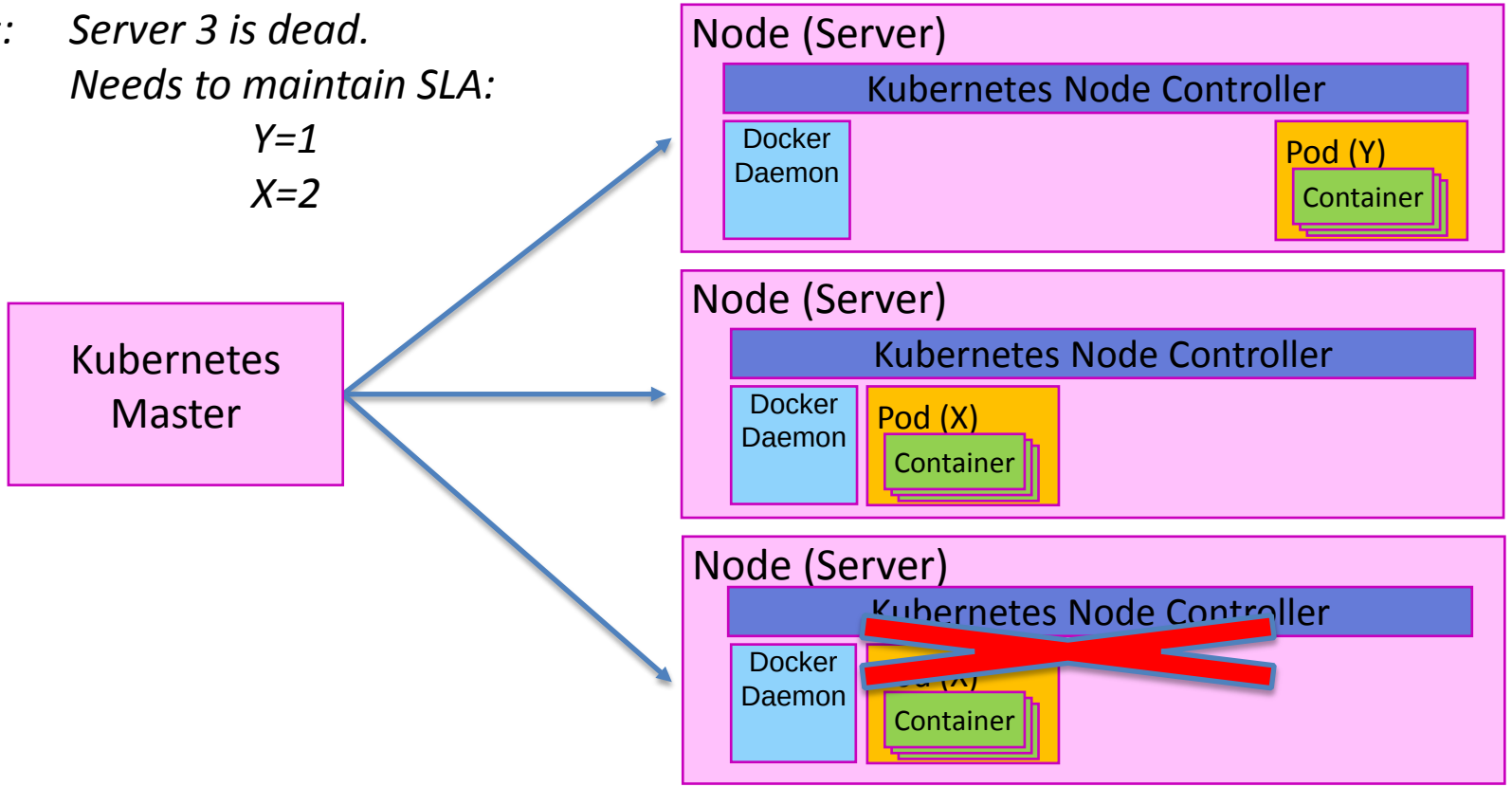


Status: *Server 3 is dead.*

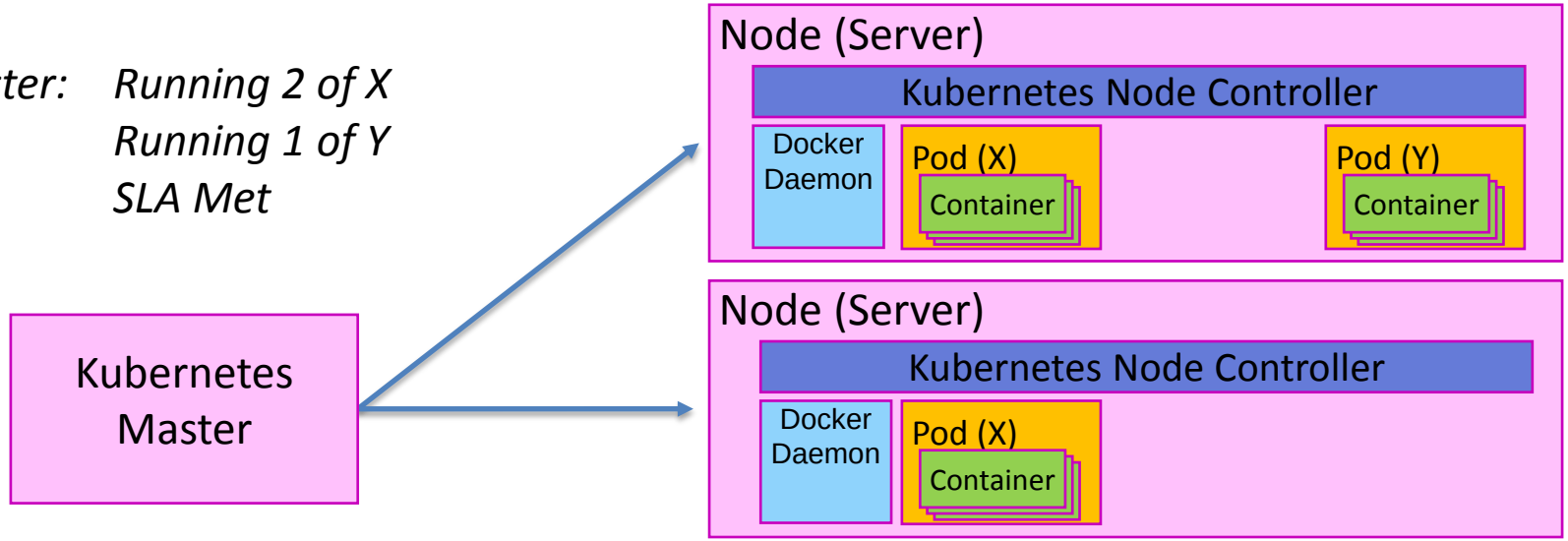
Needs to maintain SLA:

Y=1

X=2



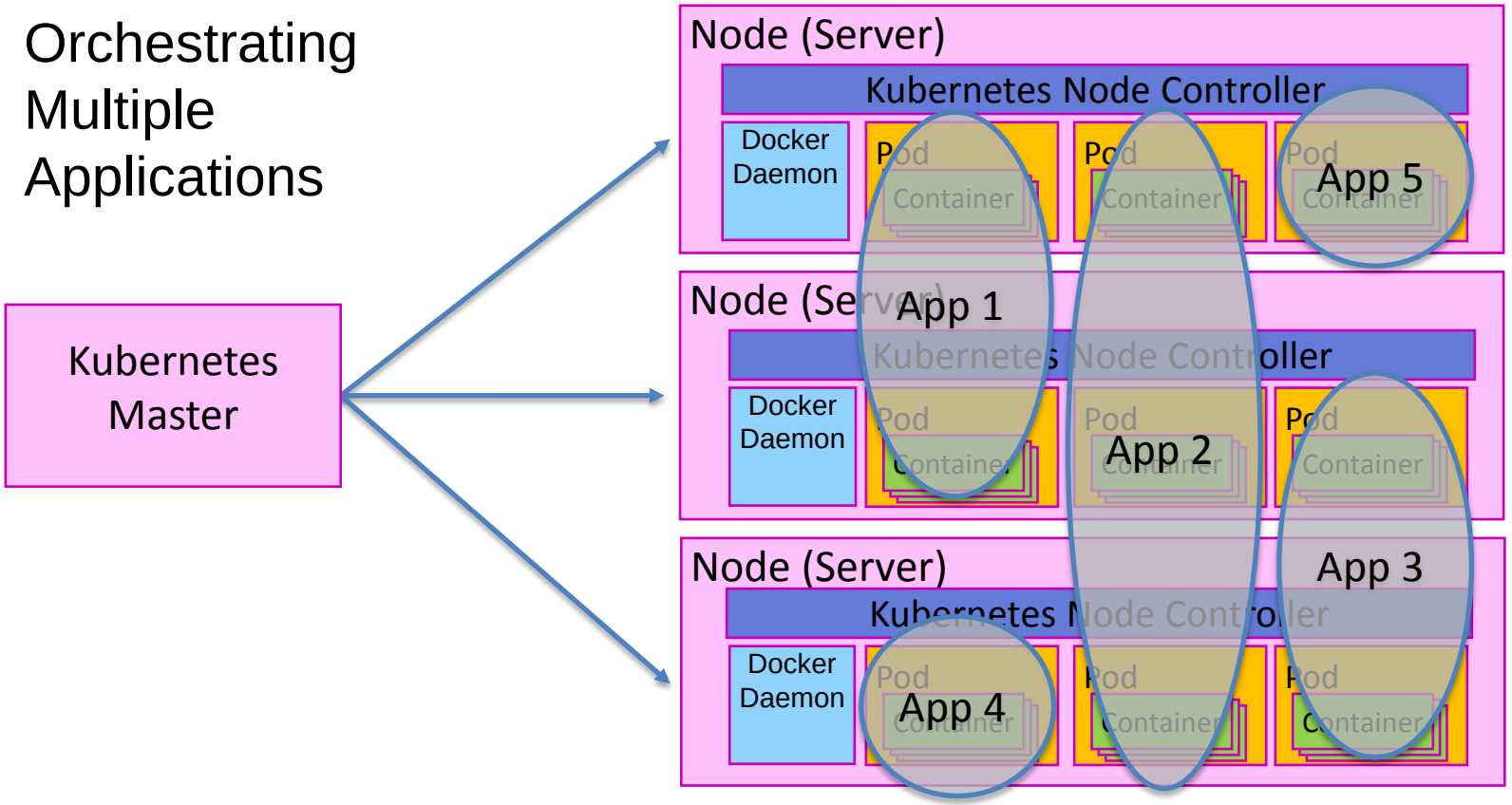
Cluster: *Running 2 of X*
Running 1 of Y
SLA Met



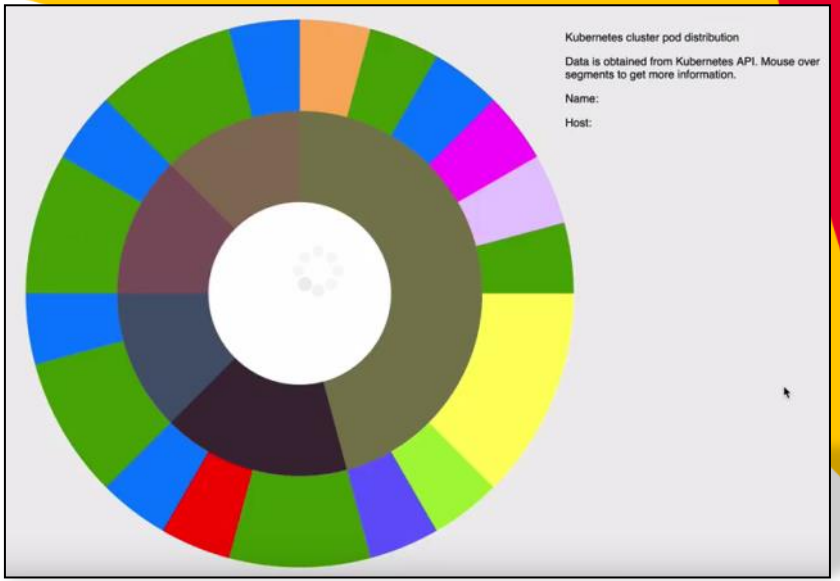
Kubernetes is a “declarative system”...

- Declare what you need “Make sure 2 of X is running”
- The system works to achieve it automatically
- This is zero-touch operations automation

Orchestrating Multiple Applications



Demo



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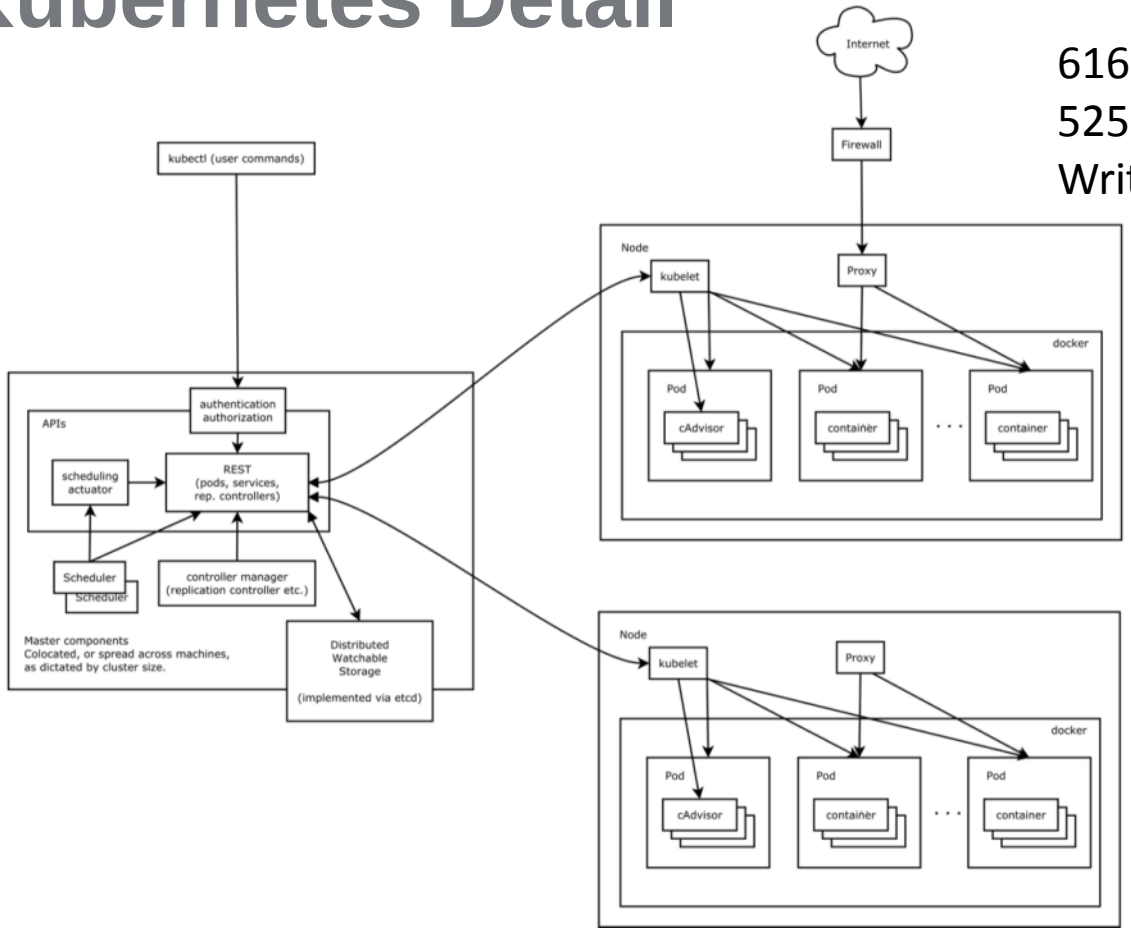
Kubernetes is for apps & datacenters

- Type I (Dedicated Cluster for an App)
  - Kubernetes manages services and applications
  - These run anywhere…
    - Amazon, Google Compute Engine, your own datacenter
    - Or a “Container Service” (e.g. GKE, Google’s Kubernetes-fueled container engine)
  - See www.github.com/samsung-cnct for a way to configure Kubernetes on AWS (GCE and bare metal in progress)
- Type II (Shared Cluster running many Apps)
  - Kubernetes manages the datacenter
  - It can host your services and apps
  - But can also manage resources supplied to others
    - OpenStack (sub-)clusters
    - Etc.

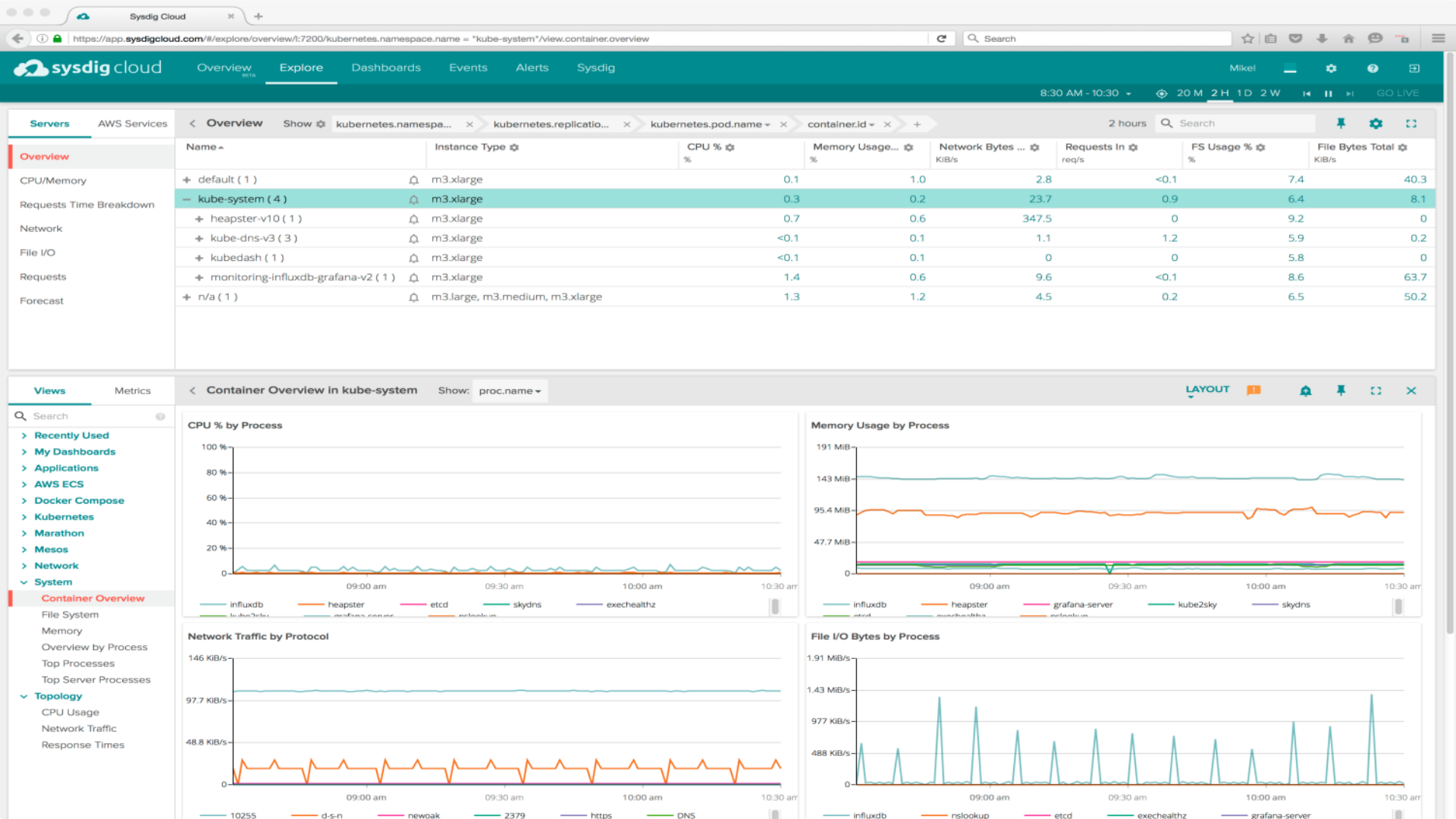
Kubernetes Detail



616K lines of code, docs, etc
525 contributors
Written in GoLang

What Else?

- Orchestration systems like Kubernetes have tooling that supports
  - Integrated load balancers. You simply describe your service endpoint and the internal connections.
  - “Canary” upgrades. (Roll-forward a little bit at a time, roll-backward)
  - Secrets & config info injection
- There’s also an ecosystem of technologies that help with deployments, e.g.
  - Sysdig: Kubernetes-aware monitoring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https://app.sysdigcloud.com/#/explore/overview/l:7200/kubernetes.namespace.name = "kube-system"/view.container.overview
Search
sysdig cloud
Overview
Explore
Dashboards
Events
Alerts
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Mikel
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Servers
AWS Services
Overview
CPU/Memory
Requests Time Breakdown
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kubernetes.pod.name
container.id
2 hours
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Name
Instance Type
CPU %
Memory Usage...
Network Bytes ...
Requests In
FS Usage %
File Bytes Total
default (1) m3.xlarge 0.1 1.0 2.8 <0.1 7.4 40.3
kube-system (4) m3.xlarge 0.3 0.2 23.7 0.9 6.4 8.1
heapster-v10 (1) m3.xlarge 0.7 0.6 347.5 0 9.2 0
kube-dns-v3 (3) m3.xlarge <0.1 0.1 1.1 1.2 5.9 0.2
kubedash (1) m3.xlarge <0.1 0.1 0 0 5.8 0
monitoring-influxdb-grafana-v2 (1) m3.xlarge 1.4 0.6 9.6 <0.1 8.6 63.7
n/a (1) m3.large, m3.medium, m3.xlarge 1.3 1.2 4.5 0.2 6.5 50.2
Views
Metrics
Search
Recently Used
My Dashboards
Applications
AWS ECS
Docker Compose
Kubernetes
Marathon
Mesos
Network
System
Container Overview
File System
Memory
Overview by Process
Top Processes
Top Server Processes
Topology
CPU Usage
Network Traffic
Response Times
Container Overview in kube-system
Show: proc.name
LAYOUT
CPU % by Process
100 %
80 %
60 %
40 %
20 %
0
09:00 am
09:30 am
10:00 am
10:30 am
influxdb
heapster
etcd
skydns
exechealthz
Memory Usage by Process
191 MiB
143 MiB
95.4 MiB
47.7 MiB
0
09:00 am
09:30 am
10:00 am
10:30 am
influxdb
heapster
grafana-server
kube2sky
skydns
Network Traffic by Protocol
146 KiB/s
97.7 KiB/s
48.8 KiB/s
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10:30 am
10255
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2379
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DNS
File I/O Bytes by Process
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977 KiB/s
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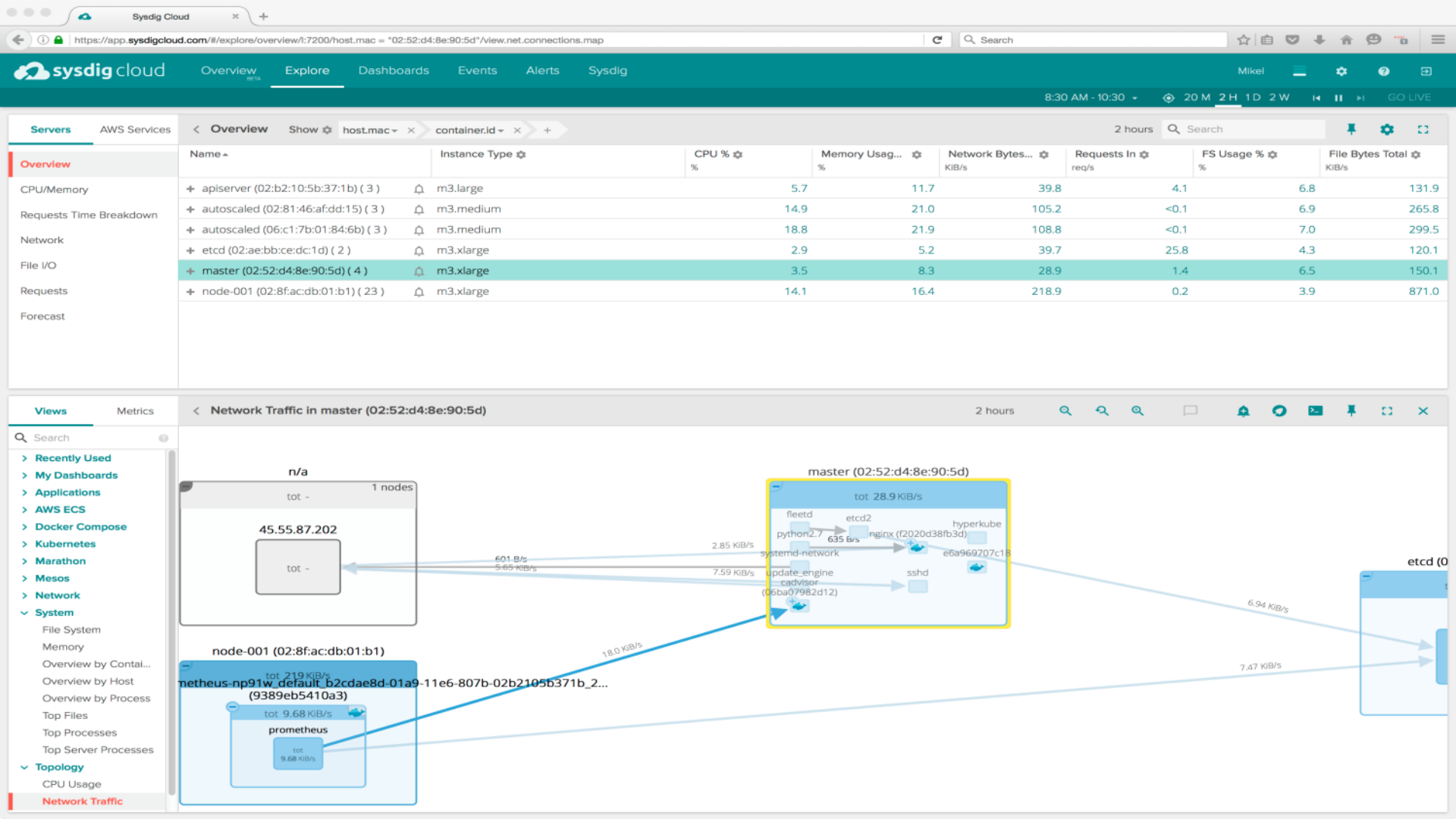
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Servers
AWS Services
Overview
CPU/Memory
Requests Time Breakdown
Network
File I/O
Requests
Forecast
Overview
Show
host.mac
container.id
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CPU %
Memory Usag...
Network Bytes...
Requests In
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apiserver (02:b2:10:5b:37:1b) (3) m3.large 5.7 11.7 39.8 4.1 6.8 131.9
autoscaled (02:81:46:af:dd:15) (3) m3.medium 14.9 21.0 105.2 <0.1 6.9 265.8
autoscaled (06:c1:7b:01:84:6b) (3) m3.medium 18.8 21.9 108.8 <0.1 7.0 299.5
etcd (02:ae:bb:ce:dc:1d) (2) m3.xlarge 2.9 5.2 39.7 25.8 4.3 120.1
master (02:52:d4:8e:90:5d) (4) m3.xlarge 3.5 8.3 28.9 1.4 6.5 150.1
node-001 (02:8f:ac:db:01:b1) (23) m3.xlarge 14.1 16.4 218.9 0.2 3.9 871.0
Views
Metrics
Search
Recently Used
My Dashboards
Applications
AWS ECS
Docker Compose
Kubernetes
Marathon
Mesos
Network
System
File System
Memory
Overview by Contai...
Overview by Host
Overview by Process
Top Files
Top Processes
Top Server Processes
Topology
CPU Usage
Network Traffic
Network Traffic in master (02:52:d4:8e:90:5d)
2 hours
n/a
1 nodes
tot -
45.55.87.202
tot -
601 B/s
5.65 KiB/s
master (02:52:d4:8e:90:5d)
tot 28.9 KiB/s
fleetd
etcd2
hyperkube
python2.7
635 B/s
nginx (f2020d38fb3d)
2.85 KiB/s
systemd-network
e6a969707c18
7.59 KiB/s
update_engine
sshd
cadvisor
(06ba07982d12)
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etcd (0
node-001 (02:8f:ac:db:01:b1)
18.0 KiB/s
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tot 9.68 KiB/s
prometheus
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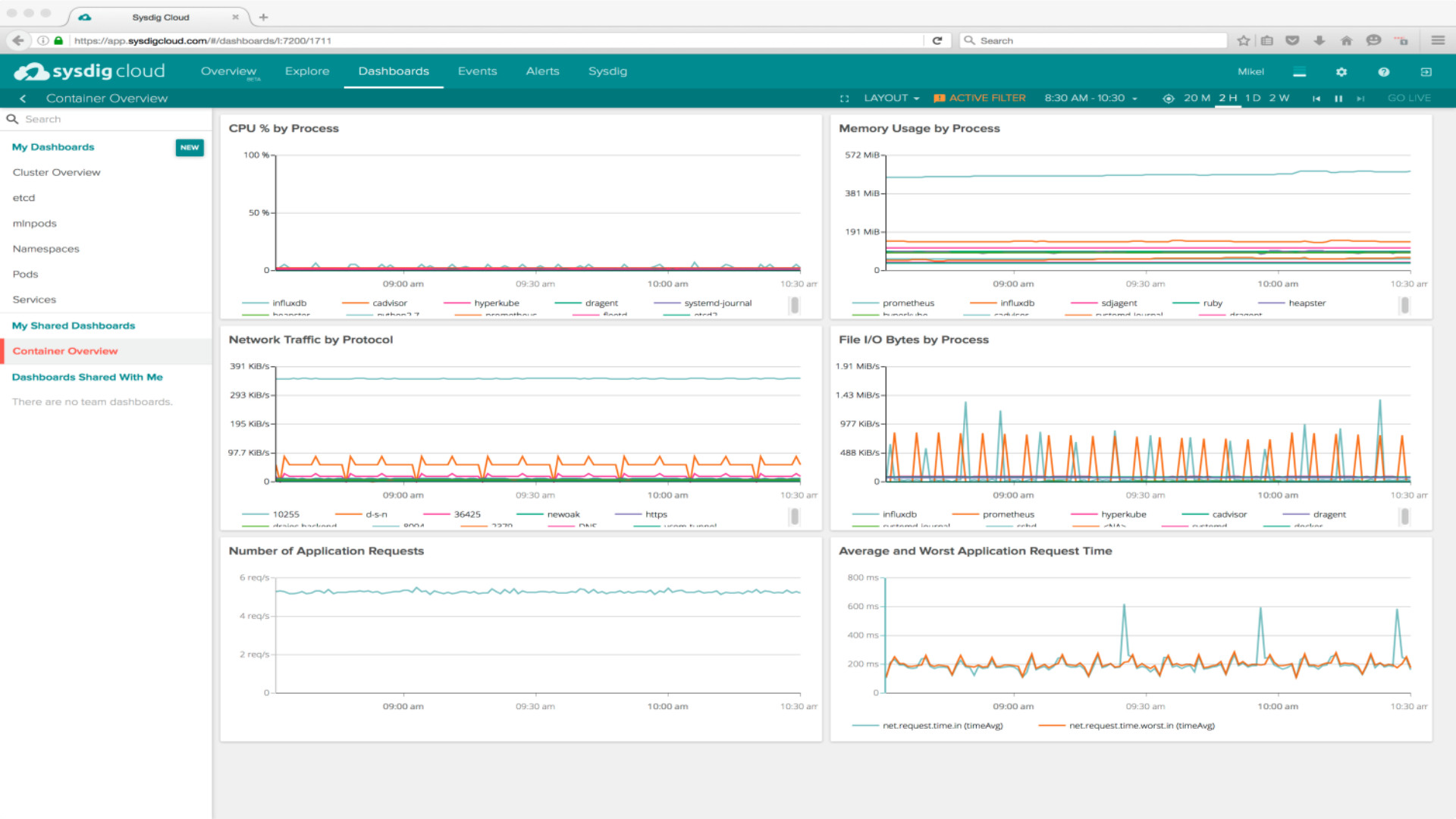
9.68 KiB/s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Overview
Explore
Dashboards
Events
Alerts
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Container Overview
LAYOUT
ACTIVE FILTER
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2 W
GO LIVE
Search
My Dashboards
NEW
Cluster Overview
etcd
minpods
Namespaces
Pods
Services
My Shared Dashboards
Container Overview
Dashboards Shared With Me
There are no team dashboards.
CPU % by Process
100 %
50 %
0
09:00 am
09:30 am
10:00 am
10:30 am
influxdb
cadvisor
hyperkube
dragent
systemd-journal
Memory Usage by Process
572 MiB
381 MiB
191 MiB
0
09:00 am
09:30 am
10:00 am
10:30 am
prometheus
influxdb
sdjagent
ruby
heapster
Network Traffic by Protocol
391 KiB/s
293 KiB/s
195 KiB/s
97.7 KiB/s
0
09:00 am
09:30 am
10:00 am
10:30 am
10255
d-s-n
36425
newoak
https
File I/O Bytes by Process
1.91 MiB/s
1.43 MiB/s
977 KiB/s
488 KiB/s
0
09:00 am
09:30 am
10:00 am
10:30 am
influxdb
prometheus
hyperkube
cadvisor
dragent
Number of Application Requests
6 req/s
4 req/s
2 req/s
0
09:00 am
09:30 am
10:00 am
10:30 am
Average and Worst Application Request Time
800 ms
600 ms
400 ms
200 ms
0
09:00 am
09:30 am
10:00 am
10:30 am
net.request.time.in (timeAvg)
net.request.time.worst.in (timeAvg)

A Few Words About PaaS

- Old PaaS integrated its own container and orchestration systems
  - Bad: segregated clusters
  - Bad: Old PaaS is good for initial dev, but a huge threshold to leave for “normal” infrastructure
- Systems like DEIS and Openshift represent new PaaS:
  - Complementary to Kubernetes: adds functionality, doesn’t replace it
- Helm: A way to package a service so that it can be easily deployed by others.

A project by engineyard

What Else Is Out There?

- Mesos (Mesosphere). Recent funding from MSFT and HPE. Just open sourced more of their “secret sauce.”
- Docker Swarm. Rapid deployment tool (dev-focused), with roadmap for more.
- Amazon, others.
- Emerging market, so will shake out, but:
  - Kubernetes is a multi-source, foundation-based open source project.
  - What we’ve bet on due to strong support from Google and others.

Samsung SDS & Kubernetes

- Focused team working on cloud native computing
- We are pushing back our work either into Kubernetes or into our github repo – www.github.com/samsung-cnct
- Very active in the community; leading the Kubernetes Scaling and Testing SIGs.
- Providing professional services to companies adopting cloud native, or to those building products for the cloud native market.

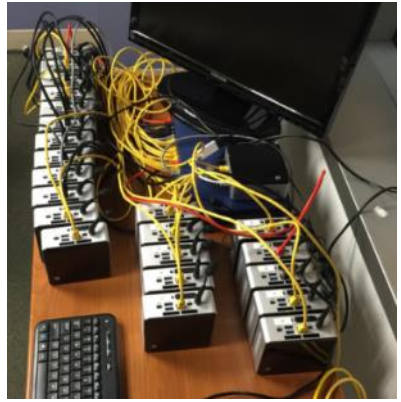
Cloud-Native Reference Stack

Ready-to-Deploy Full (v)DC Stack

www.github.com/samsung-cnct

App	Cassandra	
Orchestration	Kubernetes 1.1 → 1.2	
Networking	Flannel…	
Container	Docker	
Optimized OS	CoreOS	
Compute	AWS, GCE	Metal
Provisioning	Ansible	Rebar
	Terraform	

Stack changes based on demands and evolving technologies
Sysdig, Swift, Calico, … All under evaluation for inclusion



SDS Cloud Native Computing Team

World Class Expertise in Modern Best Practices:
Org Design, Automation, Devops, Containers,
Data Centers, Open Source

Seattle, San Diego, San Jose

Q & A

and THANK YOU for your time.

You can find links to this presentation and the demo here.

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SAMSUNG DEVELOPER CONFERENCE

https://github.com/samsung-cnct